

the same year he says that he often wonders how Newton could take the trouble to make so many researches and difficult calculations which have no foundation but this principle of universal attraction, which seems to him an absurd one.

With Leibnitz, Huygens was in fairly constant correspondence during the year 1690, chiefly on the subject of the differential and integral calculus, to which Leibnitz invited his attention; these letters have already been published more than once, but are here illustrated by several extracts from the notebooks of Huygens. After the publication of the "*Traité de la Lumière*" in 1690 (written in Paris twelve years earlier), Leibnitz wrote to express his surprise at, and satisfaction with, the undulatory theory, adding that when he saw how well it accounted for double refraction he passed from esteem to admiration. Papin also wrote to express his general approval, but otherwise there are very few allusions in the correspondence to the wonderful theory of Huygens, which had to lie dormant for more than a century before it even began to be seriously examined and to gain adherents. It is very curious that Newton should reject the undulatory theory of light while Huygens refused to accept the theory of universal gravitation, on both of which theories our modern natural philosophy is founded. But while the objections of Huygens did not retard the progress of the theory of gravitation, Newton's rival theory of light is certainly responsible for the long neglect of the true theory set forth by his Dutch contemporary.

Among the subjects which throughout Huygens' life continued to occupy his mind the improvement of clocks held one of the foremost places, and he never ceased to hope that in this way the important problem of finding the longitude at sea might be solved. Already, in 1662, he had his clocks tried at sea on a voyage from The Hague to London, but the attempt was a complete failure. Although he had in the meantime made the important invention of spiral-spring balances, he felt that even with this essential improvement no watch was to be trusted on a long voyage owing to the great influence of changes of temperature on the rate, and he therefore determined to try his pendulum clocks again at sea. In 1685 he cruised in the Zuyder Zee with two clocks suspended from the ceiling of the cabin in gimbals, and though the sea was very rough one of the clocks kept going the whole time. Encouraged by this success and being assured that the motion of a large ship would be far less violent than that which one of the clocks had been able to withstand, he had the experiment repeated in the following year in a ship belonging to the Dutch East India Company on a voyage to the Cape, giving the captain very detailed instructions as to the management and rating of the clocks. On the return of the *Alcmaer* in 1687 he learned that the clocks had kept going, though not as regularly as he had hoped. Huygens sent a lengthy report to the Company, with a large chart (reproduced in this volume) showing the track of the ship, first as estimated by the pilots, then as calculated by means of the clocks (passing right across Ireland and far to the east of the first one), and finally the same "allowing for the centrifugal force of the earth." This last track agrees fairly well with that laid down by the

NO. 1674, VOL. 65]

pilots. The matter was not lost sight of in the following years, notwithstanding the many other occupations of Huygens, and at the end of the volume we find again a number of letters exchanged between him and Graaf, who had brought the *Alcmaer* home from the Cape and who was then about to try the experiment again in another ship. But a great many years were to pass before Harrison solved the problem in quite a different manner.

It is impossible to read this splendid edition of Huygens' correspondence without being struck with the great care bestowed by the editors on their work. Throughout the volumes every allusion to persons, to contemporary events or to scientific matters is explained and commented on in footnotes, often of considerable length, which form a most valuable adjunct to the work. At the head of each letter it is stated where the original is to be found, whether it has been previously printed, and what letter it is in reply to or which one contains the reply to it. Future historians of the science of the seventeenth century will, indeed, have cause to thank the Haarlem Society of Science and especially the editors to whom this national undertaking has been confided.

In addition to the chart already mentioned, the volume contains a plate with views and plans of Hofwijck, where Huygens spent the last seven years of his life, and as frontispiece a fine portrait of the elder Constantyn Huygens from a drawing by his great son.

J. L. E. D.

ELEMENTARY BOTANY.

A Laboratory Course in Plant Physiology. By William F. Ganong, Ph.D. Pp. vi + 147. (New York: Holt and Co., 1901.)

Methods in Plant Histology. By Charles J. Chamberlain, Ph.D. Pp. viii + 159. (Chicago: University Press, 1901.)

First Studies of Plant Life. By Geo. Francis Atkinson, Ph.B. Pp. xii + 266. (Boston, U.S.A.: Ginn and Co., 1901.) Price 2s. 6d.

DR. GANONG seems to us to express sound views on the teaching of science in general and of plant physiology in particular, and the remarks on pp. 9 and 10 of his introduction might well be taken to heart by teachers; the same observation applies to his section on "Teaching and Learning," and careful consideration of the rest of this interesting manual convinces us that the author has much of the spirit of the true teacher in him. In other words, he has a share of that genius which calls forth from his students the desire to do something more than merely gather the opinions and statements of others as to the meaning of all those movements, exchanges of matter, increases in size and alterations in volume, &c., which constitute life.

It seems to us that a student who conscientiously works through the subject of this book, in the manner inculcated by the text and imbued with the spirit of inquiry manifested by the author, must learn much that is worth learning, both on account of its value as knowledge of the ways of living plants and on account of its significance in philosophy.

The experiments are as a rule simple, to the point, and

adequately but not over described; while the results, instead of being merely set forth by the teacher, have to be looked for and thought about by the student himself.

Faults there are, and probably must be in such a book, and we could criticise somewhat severely the meagre plan of a physiological laboratory submitted on pp. 29-30, and the outline course of study of structure and of the properties of protoplasm; but against these deficiencies may fairly be set some neat suggestions and devices, as, for example, those on comparative polygons (p. 15) and for experiments on germination, root-pressure, geotropism, &c. We do not like such terms or expressions as "borrowable" (p. 58), "diagramming" (p. 75), "other tropisms" (p. 132), and quite fail to understand how it can be said (p. 135) of locomotion that it is "almost purely ecological, with but a slight basis in pure physiology."

Nor can we pass over the following without protest: "5. What is the chemical composition of living protoplasm?" (p. 52). It is obvious on reflection that we know nothing of the chemical composition of *living* protoplasm.

We are also struck with the untidy appearance of some of the experiments—e.g. Fig. 13—though not all.

The information (pp. 71-72) regarding nutritive solutions, and (p. 100) water cultures is too meagre; and to say of absorption (of lithium citrate) "But perhaps such absorption is too obvious to need special experiment" is a flagrant departure from the excellent principles inculcated elsewhere.

On the other hand, surely the following precaution with the clinostat is of the order of trivialities: "The clock will need winding once in two days, and while the cork is removed for the purpose, it should be kept slowly revolving in the hands" (p. 121).

A clearly written, excellently printed and compact little handbook for the beginner in laboratory practice has long been wanted, and Dr. Chamberlain's volume comes nearer to satisfying the want than many. But it has, in our opinion, one fundamental drawback which would spoil its claims to be—what it might have been—the elementary laboratory book of methods for botanists, namely, in attempting to be both a guide to laboratory methods and a handbook of exercises in plant-histology, each of its double functions being too incomplete in treatment. For instance, the meagre description of the paraffin bath on p. 4 should either be clearer or omitted altogether, and the practical value of the curious formulæ for alcohols on p. 9 seems to us not obvious. On the other hand, the recommendation to inoculate a mouse with *Anthrax* (p. 76) can hardly apply to an elementary student, and several of the studies—e.g. of *Xylaria* (p. 83), *Marsilea* (p. 111), &c.—seem to us both unsuitable and inadequate in treatment. The poor photographic figures of nuclei in *Lilium* are also unnecessary.

In spite of these criticisms the first half of the book contains many useful hints on methods, and we should like to see it expanded, to the ultimate exclusion of the second half.

Dr. Atkinson's little book has a wealth of excellent illustrations and some ideas of value to the teacher and student of purely elementary botany or "Nature study," but it only brings out once more the clear issue that all

such teaching depends for its efficiency on the genius of the individual teacher. In the right hands, Chapters xv.-xvii., for instance, dealing with the formation of starch in the living plant, will assume delightful aspects. We do not doubt that this would be the case in the hands of the author, but even his simple style and ingenious illustrations show only the more clearly that all depends on the personality of the teacher in these fundamental matters. The section on "Battles of Plants in the World" is excellent reading, but we doubt if children could be made to appreciate the subject except in the open air and in the company of the ideal teacher, who is rarely or never present with the book.

TRUTH AND ERROR IN VON KÖLLIKER.

A. von Kölliker's Stellung zur Descendenzlehre. Ein Beitrag zur Geschichte moderner Naturphilosophie. Von Dr. Remigius Stölzle. Pp. 172. (Aschendorffsche Buchhandlung, Münster i. W., 1901). Price Mk. 2.

DR. REMIGIUS STÖLZLE, professor of philosophy in the University of Würzburg, has paid his illustrious scientific colleague A. von Kölliker a great compliment. He has dissected Kölliker's works, and separated the wheat from the chaff, as he did not long ago in the case of Karl Ernst von Baer. The analysis of nine important works, from an article on Darwinism in 1864 to the veteran's interesting "Erinnerungen" in 1899, is careful and scholarly, and the critical exposition is arranged so clearly that the reader can find out at once what Kölliker thought about variation, heredity, natural selection, or the like. While the author has very strong convictions, he expresses these with a dignified restraint, and says nothing harder against naturalists than that it is a pity to be too busy to take advantage of philosophical discipline. For those who are fond of argument the book will serve as an interesting introduction to the problems of organic evolution.

Prof. A. von Kölliker's contributions to biology—through more than half a century—have been many and varied; indeed, the magnitude of his work, alike in quantity and quality, is a lasting example to the spirit of research; and, though it is difficult always to read with patience, Stölzle's detection of "fundamental errors" is really part of a tribute to the anatomist's greatness. Is not criticism, after all, the sincerest form of flattery? But there is, by the way, a lack of discernment or of the sense of humour in placing Profs. Fleischmann and Weismann side by side among those who are responsible for recent "Angriffe oder Verdikte" on Darwinism.

The first great error is a purely mechanical interpretation of nature, the second is a denial of purposive principles, and the third is an evolution theory which is said to leave no rôle for the Creator. In evidence of these hateful heresies there is no lack of citation of chapter and verse; nor is it to be supposed that the author simply *calls* them "Irrgänge des Denkens"; he seeks to substantiate his accusations, and to those who agree with him the case will doubtless appear convincing.

But there is a brighter side to the picture; there is truth as well as error in the writings of Albrecht von Kölliker. Of permanent truth (von bleibender Wahrheit